

## ACD Decision to Use GAFE Version 7

In November 2003, ACD was required to make a decision on which version of the GAFE (analog ASIC) would be used for flight. The choice was between versions 5g and 7.

Neither version is ideal, but at room temperature, it appears that either version would be able to meet ACD requirements (or at least the essential ones associated with VETO and low-range PHA functions).

The trade-offs include the following:

1. **Both versions yield some devices that give unacceptable Bias DAC usable ranges. However, for v7 the fraction of devices exhibiting this problem is significantly lower than for v5g, which provides significantly improved yield.**
2. In v7, the shaped pulse to the PHAs has a peaking time of ~4 microsec, slightly greater than the ~3.5 microsec for v5g. This doesn't seem to be a problem.
3. The v7 high range PHA is highly non-linear, especially above ~40 pC signal. In addition, the v7 high range gain varies considerably from one device to another. The v5g high range PHA is somewhat non-linear, but is certainly better than v7. However, the high range PHA is a secondary (or lower) priority for ACD, especially above 40 pC. Also, it is self-calibrating via cosmic-ray abundance distribution peaks.
4. **Version v5g VETO has a tendency to retrigger for large signal inputs. This is a significant problem for ACD. It was fixed in v7.**
5. The v5g VETO setting is somewhat non-linear at high signal levels. Since the GAFEs probably will not operate in that range, this does not appear to be a real problem. It was fixed in v7.
6. In v7, the HLD step size exceeds the ACD spec. However, that spec is tighter than necessary, so this is not a real problem. HLD is a secondary aspect of ACD.
7. Version 7 uses about 30% less power than v5g. However, ACD power consumption is dominated by the GARCs (digital ASICs), so this is not really significant.
8. The test charge injector (TCI) in v7 is more flexible than that in v5g, and also seems to work somewhat more consistently.
9. **As shown in the accompanying table, v5g has substantially higher temperature coefficients than v7 in the VETO and Vernier step sizes, which are critical for ACD.**

Based primarily on items 1, 4, and 9 above, GAFE version 7 was selected for flight on ACD.

## Comparison of Temperature Tests on GAFE Versions 5g and 7

### Temperature Coefficients

Parameter	TC Units	Version 5g		Version 7	
		TC <sup>(1)</sup>	StDev	TC <sup>(1)</sup>	StDev
VETO Step Size	ppm/C	480	45	21	106
VETO Offset	ADU/C	0.0025	0.0003	-0.00012	0.00024
Vernier Step Size	ppm/C	575	100	5.8	110
VETO Threshold @ 56-32	ppm/C	480	315	-250	500
LE Gain	ppm/C	-78	15	-83	19
LE Offset	ADU/C	0.22	0.33	-0.18	0.54
LE ADU @ 1 MIP		0.19	0.33	-0.21	0.55
HLD Step	ppm/C	-82	85	-57	55
HLD Offset	ADU/C	-0.0031	0.0030	-0.0037	0.0079
HE Gain	ppm/C	357	37	-700	1100
HE Offset	ADU/C	-0.01	0.76	-0.068	0.244
HE ADU @ 50 MIP		-0.08	0.76	-0.13	0.25
LE/HE Crossover	ppm/C	445	241	197	210